a satisfaction to him—it was a source of the greatest pride. Whenever he had a bad turn he would always see to it that a letter was dispatched to prepare his benefactor for the worst. In the year and more of his sickness he had become an excellent judge of nursing, and his rebuke to the nurse who omitted the smallest item of his toilet was dignified but scathing.

Whatever had brought him to this pass (and he was silent on the subject), inefficiency certainly was not the cause. He selected the capable people on the hospital staff with an unfailing instinct, and their sympathy went out to him in return. Hopeless as his state was, he wasted not one moment in vain regrets, but, gathering his remaining strength, faced death with no smallest decency of life neglected. Absolutely clean and well-brushed he must be to the end, and then—a respectable burial.

I thought of him on my last night in the ward. Evidently my time to die had not come, as I was to be dismissed, cured, on the morrow; but when it did I should be glad to bear myself as well, should envy him his quiet and unfailing courage.

THE FEEDING OF INFANTS

By JOHN LOVETT MORSE, A.M., M.D.

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Everyone must admit that the natural food for a baby during the first year is human breast-milk, and that this should preferably be its own mother's milk. Unfortunately, however, the modern woman, probably as the result of civilization and unnatural surroundings, is often unable to nurse her offspring. In such cases, of course, some substitute must be provided. Every woman, however, who can, even if only partially, nurse her infant should do so, as there is no question that babies thrive better on breast-milk than on any substitute food. The mother who can but does not nurse her baby voluntarily handicaps it in its struggle for life.

BREAST FEEDING.

It is not enough, however, merely to nurse a baby; it must be nursed in the proper way. The baby must be trained to nurse at regular intervals, and only at those intervals. The proper training of a baby, and especially the regulation of its hours of feeding, almost makes the difference between its being a blessing or a curse to the family. The

baby should be put to the breast within twelve hours after birth, as this stimulates the flow of milk and accustoms the baby to nursing. If the baby is not satisfied with the small amount which it obtains in the first twenty-four or forty-eight hours, it may be given a little milk-sugar, dissolved in warm, sterile water, at each feeding after it has been put to the breast.

The intervals of feeding should vary with the age of the child. The following table shows the proper intervals for the average infant. In this table "day" means from six in the morning to nine or ten at night.

HOURS FOR FEEDING.

Age.	Intervals.	Number.	
Birth to six weeks....	2 hours.	10	One at night.
At six weeks.....	2½ hours.	8	One at night.
At two months.....	2½ hours.	7	Drop night feeding.
At four months.....	3 hours.	6	
At ten months.....	3 hours.	5	Drop 9 P.M. feeding.

If the intervals are regular, the strength of the milk remains fairly constant. Lengthening the interval weakens the milk by diminishing the total solids, and shortening the interval strengthens the milk by increasing them. It often happens that a baby that is not gaining and is crying constantly begins to gain and to be happy as soon as it is fed at regular intervals instead of every few minutes.

The baby should be fed from each breast alternately, and should nurse from fifteen to twenty minutes. If less than fifteen minutes is consumed, the baby often has colic and indigestion from taking the milk too fast. No more than twenty minutes will be consumed if the baby is kept awake and at work. The baby can take as much as he needs in twenty minutes. If it nurses steadily longer than this, there is not enough milk in the breast.

The average normal human breast-milk contains about four per cent. of fat, seven per cent. of sugar, one and a half per cent. of proteids (albuminoids), and a small amount of mineral matter. The rest is water. It is sterile, alkaline in reaction, and contains no starch.

	Fat.	Sugar.	Proteids.	Reaction.	Sterility.
Human milk.....	4.00	7.00	1.50	Alkaline.	Sterile.

The variations in human milk are very considerable, however, not only between different milks, but between the same milk on different days and hours. Variations within moderate limits do not, as a rule, disturb the infant's digestion. Milk may be bad, however, in quantity or in quality.

The quantity of milk may be increased by improving the mother's general condition and by giving liquids. Preparations of malt are especially useful in increasing the flow of milk. The quantity may be diminished by cutting down the amount of liquids taken and by opening the bowels.

While the quality of milk may differ from the normal in many ways, three main classes are usually recognized,—the over-rich, the poor, and the bad. In the over-rich all the solids are increased. An example of the over-rich is, fat, 5.25 per cent.; sugar, 7.50 per cent.; proteids, 3.50 per cent. This sort of milk is due to the combination of too much and too rich food and laziness. It is easily remedied by starvation and exercise. In the poor milk the fat and sugar are usually low and the proteids high. An example of this form of milk is, 1.25 per cent. fat, 4.00 per cent. sugar, and 2.50 per cent. proteids. This form is due to insufficient nourishment, usually in combination with overwork. As a rule, it can be remedied by feeding and rest. In the bad milk the fat and sugar are very low and the proteids very high. An example of this form is, 0.75 per cent. fat, 5.00 per cent. sugar, and 4.50 per cent. proteids. This form is almost always due to nervousness and can seldom be remedied.

While too much fat and sugar cause certain minor disturbances, the chief cause of trouble is found in increased proteids. In general, if breast-milk does not agree, the trouble is to be sought in the proteids.

Much can be done to modify the constituents of the milk. The amount of fat and proteids can be controlled to a certain extent. The amount of sugar, however, cannot be changed. The amount of fat depends on the amount of meat in the diet, varying directly with it. The amount of proteids varies with the amount of exercise, exercise diminishing them. Over-exertion, however, increases them.

If a mother cannot nurse her infant, some substitute must be provided. This may be a wet-nurse or some artificial food.

WET-NURSES.

There can be no question that the milk of another woman is the best substitute for the mother's milk. No other food can entirely fill the place of human milk. Wet-nurses, however, are not an unmixed blessing. One of the Harvard professors defines them as one part cow and nine parts devil. Nevertheless, a mother should be willing to submit to any amount of annoyance and inconvenience in order to save the life of her child. Fortunately, it is usually possible to dispense with a wet-nurse. In some cases, however, a wet-nurse is absolutely necessary, even the most careful artificial feeding proving unsatisfactory.

ARTIFICIAL FEEDING.

Certain rules must be observed in the artificial feeding of infants as well as in breast-feeding. The intervals should be the same in both cases.

In artificial feeding, moreover, it is necessary to suit the amount of each feeding to the size and age of the individual child. The supply of milk provided by nature corresponds to and varies with the needs of the child within fairly narrow limits. There is no constant relation, however, between the size of the nursing-bottle and that of the baby's stomach. A two-ounce stomach will not hold a pint of milk. The proper amounts for each feeding at various ages have been determined by weighing babies before and after breast-feedings and by measuring the capacity of stomachs after death. The amounts for each feeding at the various ages are in a general way as follows:

One week	1 ounce.
Four weeks	2½ ounces.
Three months	4 ounces.
Six months	6 ounces.
Nine months	8 ounces.

The composition and strength of the food must also vary with the age of the child. Breast-milk varies but little during the whole period of nursing. It has been found by experience, however, that a young baby cannot take as strong an artificial food as an older one. In a general way the strength of the food should increase with the age of the child. The following table shows the average strength suitable for various ages:

	Fat.	Sugar.	Proteids.
First days	2.00	5.00	0.50
Second week	3.00	6.00	0.75
One month	4.00	7.00	1.00
Two months	4.00	7.00	1.50
Four months	4.00	7.00	2.00
Six months	4.00	7.00	2.50
Eight months	4.00	7.00	2.75

All babies of the same age cannot take the same strength of food. Individual peculiarities play an important part, and the food must be varied to suit the special infant. The child, and not general rules, must be followed in preparing the food.

The following propositions regarding an artificial food are certainly justified: Any substitute for breast-milk must be like it. That substitute is best which is most like it. This substitute must be easy to obtain and easy to prepare. It must not contain substances not normally found in human breast-milk. It must be free from bacteria, be alkaline, and contain the normal constituents of breast-milk in their normal propor-

tions. It must be susceptible of modification to fit individual cases. No proprietary or patent food exactly fulfils the above conditions. The following table is evidence of the truth of the above statement.

Condensed milk,*	Fat.	Sugar.	Proteids.	Starch.	Reaction.
Eagle Brand, 1-12...	0.53	3.90 ⅘ cane.	0.65	0.00	Acid.
Nestle's Food †.....	0.36	0.84 milk. 2.57 cane.	0.81	1.99	Alkaline.
Imperial Granum †....	1.54	2.71	2.15	1.22	Alkaline.
Malted milk †.....	0.68	1.18 milk. 3.28 maltose. 0.92 dextrin.	1.15	0.00	Alkaline.
Mellin's Food †	2.89	3.25 milk. 2.20 maltose. 0.53 dextrin.	2.62	0.00	Alkaline.

There is no absolute substitute for human milk. Cows' milk, however, can be modified to fulfil the conditions laid down above. Some modification of cows' milk, therefore, is the only proper and practicable substitute for human milk. The analysis of average cows' milk is as follows:

	Fat.	Sugar.	Proteids.
Cows' milk.....	4.00	4.50	3.85

A comparison with breast-milk shows certain differences.

	Fat.	Sugar.	Proteids.	Reaction.	Sterility.
Human milk..	4.00	7.00	1.50	Alkaline.	Sterile.
Cows' milk ...	4.00	4.50	3.85	Acid.	Not sterile (when obtained by child).

It is evident that while the fat is the same in both cases, the sugar is lower and the proteids higher in cows' milk than in human milk. Moreover, the proteids are somewhat different, those in cows' milk forming larger curds. Cows' milk is acid, where human milk is alkaline; it contains bacteria, while human milk is sterile. In order to resemble human milk, therefore, cows' milk must be made alkaline and sterile and the proportions of the solids changed.

The acidity is easily corrected by the addition of an alkali, preferably lime-water. The entrance of bacteria can to a large extent be prevented by care in obtaining the milk and their toxic action inhibited by Pasteurization. The deficiency in sugar is easily made up by the addition of a sufficient amount of milk-sugar. The difficulty comes in the fat and proteids, for, while the percentage of fat is the same in both cases, that of the proteids is much higher in cows' milk. Any dilution of the milk

* Holt, "Infancy and Childhood," 1897, p. 149.

† Chittenden, *New York Medical Journal*, July 18, 1896. (Foods prepared according to directions for six months.)

to lower the percentage of proteids must, therefore, affect that of the fat also and render it too low. Proper modification by simple dilution is, therefore, impossible. In some way the percentage of proteids must be diminished, while that of the fat is retained unchanged. This is rendered possible by the fact that when milk is separated, either by gravity or by centrifugalization, the sugar and proteids remain nearly equally distributed throughout the mixture, while the fat is very unequally divided, being almost entirely contained in a certain small portion. It is upon this principle that the whole process of modification, both in the laboratory and at home, is based.

LABORATORY FEEDING.

There can be no question that modified milk can be prepared more accurately in the laboratories established for the purpose than it can be at home. Having their own farms, they are able to control their supply of milk and are sure to have it fresh and obtained under the best possible conditions. Moreover, by daily analyses of the milk and cream used in modifying they are able to furnish just the modifications desired. In ordering milk from the laboratories it is merely necessary to state in percentages just what modification is wanted. The laboratory does the rest. The following is the usual form of prescription:

	Per cent.	
℞ Fat		Number of feedings
Milk-sugar		
Proteids		Amount at each feeding
Mineral matter		
		Alkalinity ..... per cent.
Total solids		
Water		Heat at ..... °F.
	100.00	

It is thus evident that the laboratory does not provide any special form of food, but merely furnishes what is ordered by the physician. It corresponds exactly to the apothecary. Modified milk, therefore, is not an entity, a single food, always the same, but merely a convenient name for an almost infinite variety of foods, all, however, prepared from cows' milk.

Laboratories for the modification of milk have been or are being established in most of the large cities of this country. To those who live in these cities they offer the most convenient way of obtaining modified milk. They are of little value, however, to those who live in the country and at a long distance from them. Moreover, the cost of modified milk prepared at the laboratory is prohibitive to poor people, even in the city, the minimum cost being three dollars and a half a week.

When, because of distance, expense, or other reasons, feeding from a laboratory is impossible or inadvisable, modified milk can be very satisfactorily prepared at home.

HOME MODIFICATION OF MILK.

As already stated, the principle upon which the modification of milk depends is that when milk is separated, either by gravity or by centrifugalization, the sugar and proteids remain nearly equally distributed throughout the mixture, while the fat is very unequally divided, being almost entirely contained in a certain small portion. In this way only can the proper relations of fat and proteids be obtained. The amount of fat in the various portions of milk, separated by gravity, depends on the time it is allowed to set.

It has been found that when average cows' milk has been set for four hours the composition of the upper one-third is as follows: Fat, 8.00; sugar, 4.50; proteids, 3.85.

When it has been set for six hours the composition is as follows:

	Fat.	Sugar.	Proteids.
Upper one-fifth	12.00	4.40	3.75
Upper one-fourth	10.00	4.50	3.85
Lower three-fourths	2.00	4.50	3.85
Lower one-fourth	0.25	4.50	3.85

The cream of milk set for twelve hours or more has the following composition: Fat, 16.00; sugar, 4.20; proteids, 3.60.

It is evident, however, that these figures are not constant, but must vary with the composition of the specimen of milk set. No modification of milk based on them, therefore, can be absolutely accurate. As absolute accuracy is impossible, it is advisable, as a rule, in order to avoid small fractions of a per cent. and complicated calculations, to always call the percentage of sugar 4.50 and that of the proteids 4.00. The errors introduced in this way are comparatively unimportant. The percentages of sugar and proteids obtained are, of course, lower than calculated. Small variations in the amount of sugar never cause trouble, however, and when proteids make trouble it is always because they are too high. The corrected figures are, therefore, as follows:

	Fat.	Sugar.	Proteids.
Whole Milk	4.00	4.50	4.00
Set 4° —Upper one-third	8.00	4.50	4.00
Set 6° —Upper one-fifth	12.00	4.50	4.00
Upper one-fourth	10.00	4.50	4.00
Lower three-fourths	2.00	4.50	4.00
Lower one-fourth	0.25	4.50	4.00
Set 12°+—Cream layer	16.00	4.50	4.00

It is customary to speak of the portions of set milk containing more than four per cent. of fat as "creams,"—*e.g.*, eight per cent. cream, ten per cent. cream, and so on. The top cream as delivered in the jars averages about sixteen per cent. Creams higher than sixteen per cent. are usually obtained by centrifugalization.

The best way to obtain the various creams is by siphoning off the lower portions, leaving the cream in the jar. Approximately the same results are obtained, however, by pouring it off. The milk is best set in glass jars.

In order to obtain the formulæ necessary for the preparation of modified milk at home, it is necessary to think and calculate in percentages of fat, sugar, and proteids, and not in quantities of cream, milk, sugar, and water. The various quantities of the different ingredients of the mixture must not be regarded as the primary factors, but merely as the results of the problem. They represent, not the ultimate elements of the food, but only the means by which these elements are obtained. In this way only can even approximately accurate results be attained. In fact, the scientific feeding of infants in general is impossible except on the percentage basis of computation.

In calculating any formula for the home modification of milk it is first necessary to determine the percentages of fat, sugar, and proteids, the alkalinity, and the total amount for twenty-four hours desired.

Many methods have been devised for the calculation of the formulæ for the preparation of modified milk, most of which are fairly satisfactory. One of the simplest and easiest to follow is that devised by Baner, based on various strengths of cream and whole milk. (*New York Medical Journal,* March 12, 1898.)

Quantity desired for 24 hours (in ounces), Q.
Desired percentage of fat, F. C, Cream.
Desired percentage of sugar, S. M, Milk,
Desired percentage of proteids, P. L W, Lime-water.
Desired percentage of alkalinity, A.

Cream..... $\frac{Q}{\text{Percentage of fat in cream} - 4} \times (F - P)$.

Milk..... $\frac{Q \times P}{4} - C$.

Lime-water..... $\frac{A}{100} \times Q$.

Water..... $Q - (C + M + L\,W)$.

Dry milk-sugar..... $\frac{(S - P) \times Q}{100}$.

For example, suppose a forty-eight-ounce mixture of the proportions of four per cent. fat, seven per cent. sugar, two per cent. proteids,

and of ten per cent. alkalinity is desired. Suppose sixteen per cent. cream is to be used in preparing the mixture:

Cream ..... $\frac{48}{12} \times (4 - 2) = 8$ ounces.

Milk ..... $\frac{48 \times 2}{4} - 8 = 16$ ounces.

Lime-water ..... $\frac{10}{100} \times 48 = 4.8$ ounces or 5 ounces.

Water ..... $48 - (8 + 16 + 5) = 19$ ounces.

Milk-sugar ..... $\frac{(7-2) \times 48}{100} = 2.4$ ounces or $2\frac{1}{2}$ ounces.

(A rounded tablespoon of milk-sugar is equal to about half an ounce.)

The usual percentage of lime-water for well babies is five. If the digestion is not quite right, ten or fifteen is better.

After the alkaline mixture of the desired proportions has been prepared, one more step is necessary in order to fulfil the conditions laid down for a substitute food: the bacteria must be destroyed. When the milk is very fresh, the weather cool, and the infant well, Pasteurizing the milk may be safely dispensed with. All cooking of milk is undoubtedly somewhat of a disadvantage, as certain changes are produced in the milk by heat which render it less easy of digestion. These changes are of little importance, however, in comparison with those which are produced by bacteria. When there is any doubt whatever about the freshness or cleanliness of the milk supply, in warm weather and when the baby is not well milk should always be Pasteurized to destroy the bacteria. A temperature of 155° F. for twenty minutes is sufficient, but one of 167° F. is safer if people are at all inclined to be careless.

The apparatus needed for the preparation of modified milk at home is as follows:

Jars.—One or two glass jars to set the milk in. The jars in which milk is usually delivered are the best. Mason's fruit-jars are perfectly satisfactory.

Bottles (to hold the milk).—Those made by Whitall & Tatum for the Arnold Sterilizer are the best available at a moderate price. They retail at five cents apiece, or forty cents a dozen for the large size and thirty-four cents a dozen for the small size. The Walker-Gordon Laboratory sells a somewhat better-shaped but more fragile bottle for ten cents apiece, or one dollar a dozen.

Siphon.—A piece of glass tube suitable for this purpose can be bought for eight cents and bent at home.

Thermometer.—A thoroughly reliable thermometer can be purchased at the laboratory or at drug-stores for fifty cents. Cheaper ones

can be obtained for twenty or twenty-five cents, but they are not always trustworthy.

Graduate (measuring ounces).—A satisfactory four-ounce graduate can be purchased of any of the wholesale druggists and at many of the department stores for nineteen cents.

Cotton Stoppers.—Ordinary cotton wadding, at thirteen cents a roll, is perfectly satisfactory for this purpose.

This is all the apparatus that is necessary and costs only a dollar and thirty cents.

A tin pail or dish does perfectly well for Pasteurization. If a special apparatus is desired, however, it can be obtained from the Walker-Gordon Laboratory for four dollars, or Freeman's Pasteurizer may be obtained of J. S. Dougherty, 411 West Fifty-ninth Street, New York, for three dollars and fifty cents.

The method of preparing the milk is as follows, the part to be siphoned off varying, of course, with the percentage cream to be used:

Wash thoroughly and scald the glass jars, bottles, graduate, and siphon every day before using. As soon as the milk comes put pints in the jars, cover, and set it in a cool place for hours. At the end of this time siphon off the lower of the milk into a clean dish. Start the siphon with water. Then mix in a clean dish in the following proportions:

Cream.....
Milk.....
Lime-water.....
Boiled water (not boiling).....
Sugar of milk.....

Then put ounces of this mixture in each of bottles and stopper tightly with cotton. Place these bottles upright in a dish of cool water, the water in the dish being at the level of the milk in the bottles. Put the dish on the stove and heat until the thermometer in the water reaches 167° F. Then take it off the stove and cover with an old blanket or comforter. Leave this on for twenty minutes. Then take out the bottles, set them in a cool place, and keep them there.

This process may seem long and complicated, but in practice it is not. It usually takes from three-quarters of an hour to an hour to do the whole thing, including the Pasteurization. This is all the time, however, that is required for twenty-four hours. I have found it most satisfactory both in private and hospital practice.

The cost of home-modified milk varies, of course, with the age of the child and the consequent strength and amount of food used. It

varies from about fifty cents a week for a two-weeks-old baby to a dollar and seventy-five cents a week for an eight-months-old baby.

Certain precautions are necessary in the use of modified milk, whether prepared at the laboratory or at home. It should be kept on ice. It must be warmed in the bottle. It must never be poured out to be warmed. The bottle is to be placed upright, with the cotton still in it, in a dish of cool water, the water outside being level with the milk in the bottle, then heated until the thermometer in the milk reaches 100° F., the proper temperature for the baby's food. When the milk is warm the nipple is to be put directly on the bottle. A knitted cover helps to keep the milk warm while the baby nurses. If the baby does not take all the food at a feeding, the residue is to be thrown away and a fresh bottle used next time. The same bottle of milk must never be used twice. The nipples should be washed thoroughly after each feeding and kept in soda and water. It is advisable to boil them at least once a day. The infant should have nothing besides the modified milk, except water which has been boiled and cooled. It may have an unlimited amount of that.

THE DISCUSSION ON TUBERCULOSIS

By RUTH BREWSTER SHERMAN
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THE interest which every nurse has felt in the September meeting of the Congress of Nurses should not in any degree draw her attention from an event which has recently startled the medical world.

The International Congress on Tuberculosis assembled in August in London, and before that profound body of distinguished men Dr. Koch, whose name is synonymous with the struggle against the most prevalent disease in the world, announced that his researches had led him to the conclusion that the tubercle bacillus of cattle is not identical with that of man, and that, consequently, the contracting of tuberculosis by the use of meat and milk from infected animals is not probable.

Lord Lister and the great body of American, English, and European scientists absolutely oppose this view, so contradictory to the practical experience and the best teaching for years past. The warning against tubercular meat and milk has been heard in every medical lecture and read in every medical book since Villemin's famous researches in 1865, and no other event has given such an impetus to opinion as Koch's own isolation of the tubercle bacillus in 1882. Urged by the physicians